Let A C (Fig. 6) be the width of the groin arch, and D B its height. Join A B, and divide it into the same number of parts as C B in Fig. 5 ; and draw through the points 1, 2, 3, 4 the lines D 1, D 2, D 3, D 4. Then from A draw a line perpendicular to A C, and transfer to it the divisions from the corresponding line in Fig. 5 ; and from these divisions draw lines to B. The intersection of these lines with the lines D 1, D 2, etc., will give points through which the curve may be traced.

To draw an ogee arch.—Divide the width A B (Fig. 7) into four equal parts in *d, c, e ;* and on *d, e* erect the square *d, f, g, e.* The points *d, e, f, g,* are the centres of the four quadrants A *k, k l,* B *h, h l,* composing the arch.

Another Method.—Let A C (Fig. 8) be the width and D B the height of the arch. Join A B, B C, and bisect the lines in *e, f ;* then from the centres, A, *e,* B, *f,* C, with the radius A *e* or *e* B, describe the arcs intersecting in the points *g, h, k, l,* which are the centres of the four arcs composing the ogee arch.

Another Method.—When the arch is equilateral. Bisect A B (Fig. 9) in C, join A *h,* B *h.* From C, with the radius A or B, describe the arcs A *d,* B *e ;* then, to find the centres of the other arcs, from the points *d, e,* and *h* as centres, and with the same radius as before, describe arcs intersecting each other in the points *f* and *g,* which are the centres of the arcs *h d, h e.*

Lessons in Projection.

By Robert Riddell, Teacher of the Artisan Class in the High School, Philadelphia, Pa.

Projection of Straight Lines and Curves.—Let A (Fig. 1, Plate 39) be the given plan, and B C the angle of projection. Draw perpendiculars through the plan, cutting B C. The distances thus given on the angle are transferred to the line C D, from which trace the different members that are to project and intersect with those of plan A.

The elliptical curve K R is obtained by finding two foci as N L, in which fix two pins as shown ; then with a piece of thread and a pencil strike the curve the usual way ; this curve, when in position, will be found to stand directly over the quarter circle shown on plan A. This principle of obtaining a curve is precisely the same as for finding the section of a cylinder when cut by a plane not parallel with the base.

To understand and form correct ideas of complex problems of this kind, there is no better way than by making a drawing of each one on card-board, and then cutting it at the lines so that it will fold up to the desired shape. If the cut parts do not come freely together without twisting or buckling, there will be some error in the constructive principle which can generally be speedily rectified. It will be seen that by adapting this method of testing problems many serious mistakes may be avoided.

In the problem before us the lines to be cut are marked with crosses, and the bases of these cut parts are marked *o, o, o.* Now let us take that part marked B *x x x x,* and raise it on the folding line *o o* until it is perpendicular with the plan A. Then take the part D K, R S, and C, and fold over at the base line *o o* until it lays on the inclining line B C ; it will be seen then that the work is correct, as the lines on D will stand perpendicularly over the corresponding lines on the plan A.

The parts S S should be removed, as by doing so a better idea of the working of the problem will be obtained.

The method of teaching projection by cutting cardboard has many advantages over all other modes of instruction ; in fact, it is a workshop operation, as the pupil sees before him a model of the work, and is thereby better able to proceed with the work when putting it in actual practice.

The Sectorian System of Hand-Railing.

FIFTH PAPER.

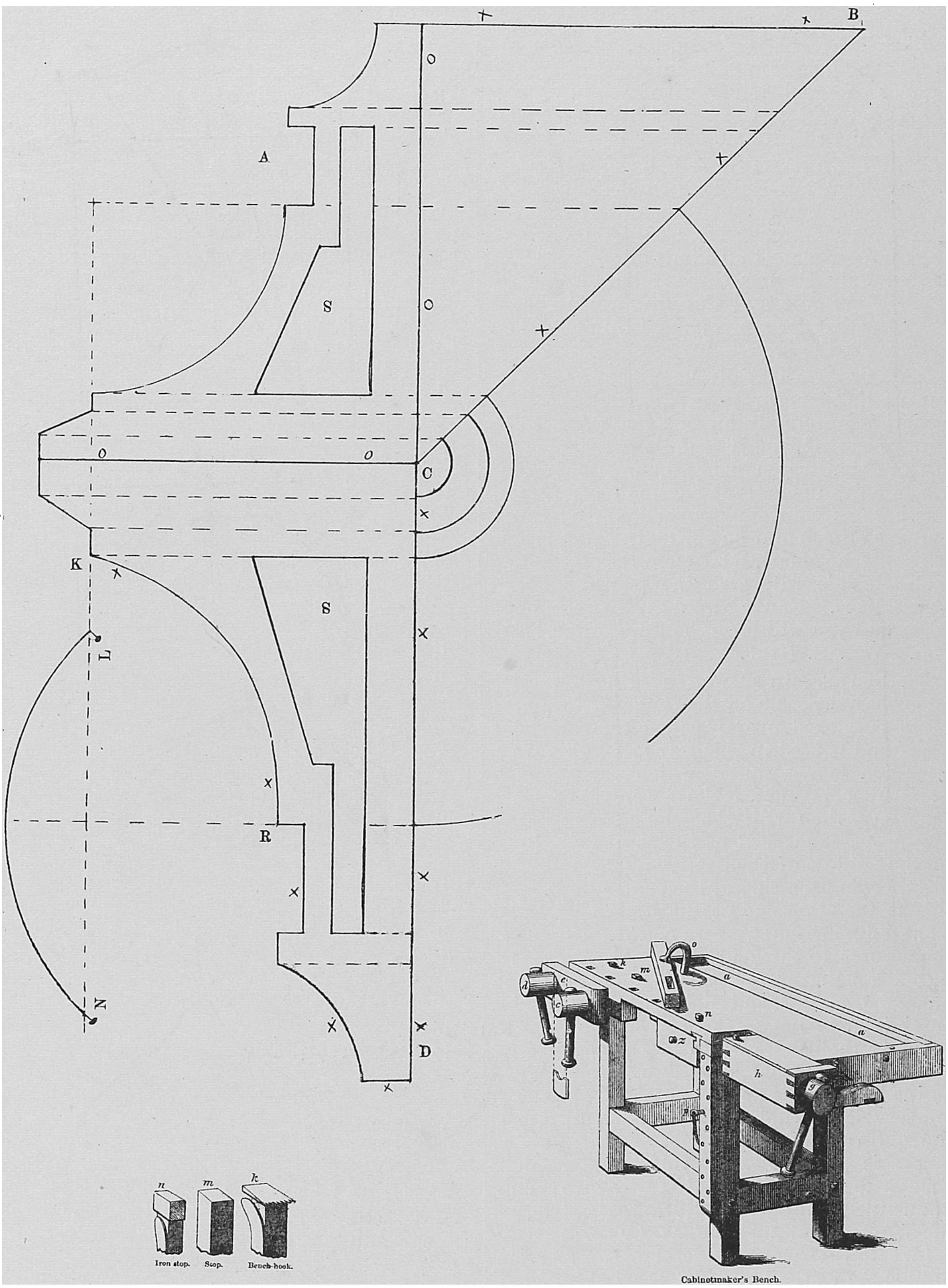
Fig. 1 (Section 1, Plate 34) in this example shows the ground plan of platform stairs, with one half the landing and ascending treads placed in the platform. The cylinder is of larger size than is generally used for this kind of stairs, and I give this example to show that as easy and as graceful a wreath can be thrown around this as any of smaller size.

Fig. 2 is the lower piece of wreath with a part of straight rail attached. The sections of rail at each end show the direction given by the spring and plumb bevels, which are the same. The bevel, Fig. 6, astride the tangents of this figure shows the angle as obtained on the sector, Fig. 3, which, when folded to an angle of ninety degrees and each blade placed on the line, shows the pitch of half a riser from the chord line to the centre of the cylinder. The angle is obtained, as shown, for getting the tangents of one half the wreath, one mould answering for both pieces by reversing the end. The shank may extend as far as the thickness of stuff will allow.

Fig. 3 is the sector with the line showing the rise, and the horizontal lines, giving the height of half a riser.

Fig. 4 is the shape of the outside falling mould, and is obtained by getting the stretch-out of convex side of wreath from face of the

PLATE 39



Cabinetmaker's Bench.

LESSONS IN PROJECTION